

[illegible]

Day 2: The Problem Solving Formative Assessment Lesson

Goals for Day 2

- Review the MDC Initiative and Concept Development Formative Assessment Lesson.
- What are the benefits of non-routine problem solving?
- What does a teacher need to understand when implementing a non-routine problem?
- Look at how MDC Problem Solving FALs merge collaborative problem solving and formative assessment to create more confident problem solvers.
- Plan for Implementation.

Welcome Back!

QUIZ TIME

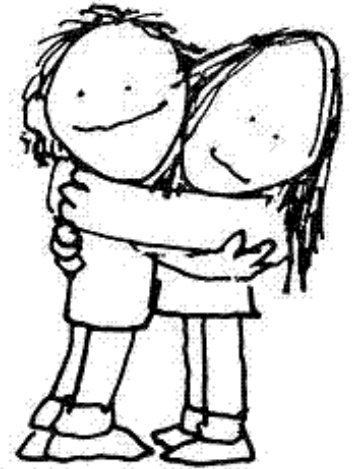


What do you know about MDC?

Step 1:

Go to Kahoot.it

Sharing is Caring...

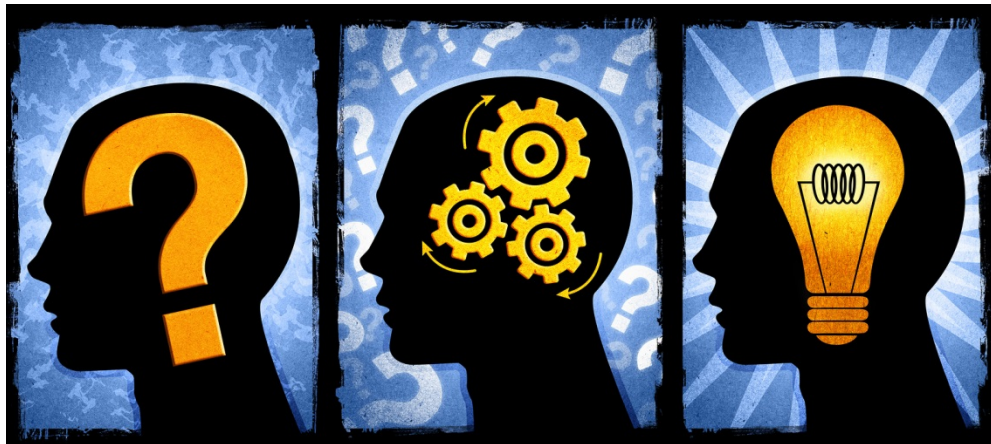


- Is there a Concept Development Lesson that you like? Why?
- What changes would you have to make to the lesson, if any?

-OR-

- Do you have an idea for a Concept Development Lesson that you would like to create?

Let's Talk Problem Solving



Stuck on an Escalator...Look Familiar?



What does problem solving look like in your classroom ?

&

How do you envision it looking?



Additional Thoughts:

- How often does problem solving occur?
- Is it embedded or stand alone after a unit?
- How does your vision differ from your current practices?

“The value of an education is not the learning of many facts, but the training of the mind to think.”



“It’s not that I’m so smart,
it’s just that I stay with
problems longer”

- *Albert Einstein*

The Typical Textbook Problem...



You have the job of organizing a table tennis tournament.

- 7 players will take part
- All matches are singles.
- Every player has to play each of the other players once.

1. Call the players A, B, C, D, E, F, G
Complete the list below to show all the matches that need to be played.

A v B B v C
A v C B v D
.....

2. There are four tables at the club and each game takes half an hour.
The first match will start at 1.00pm.

Copy and complete the poster below to show the order of play,
so that the tournament takes the shortest possible time.
Remember that a player cannot be in two places at once!
You may not need to use every row and column in the table.

Start Time	Table on which the game will be played			
	1	2	3	4
1.00	A v B			
1.30				
2.00				
2.30				
3.00				
3.30				
4.00				
4.30				

**What are your thoughts
about the typical
textbook problem solving
opportunities?**

Comments/Concerns?

What would make the Tennis
Problem better?

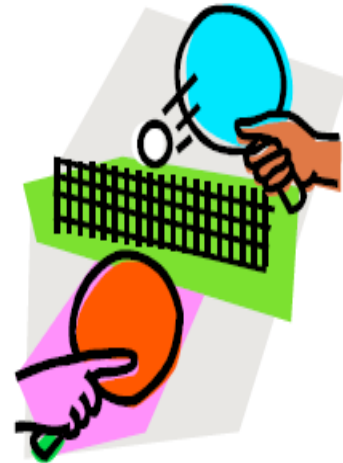
...and Discuss!

Is this better? If so, why?

Organizing a table tennis tournament

You have the job of organizing a table tennis league.

- 7 players will take part.
- All matches are singles.
- Every player has to play each of the other players once.
- There are four tables at the club.
- Games will take up to half an hour.
- The first match will start at 1.00pm.



Plan how to organize the league, so that the tournament will take the shortest possible time. Put all the information on a poster so that the players can easily understand what to do.

**Problem solving means engaging
in a task for which the solution
method is not known in
advance.**



**It involves a situation
in which a person
wants something and
does not know
immediately what to
do to get it.**



What are the benefits of Non-Routine Problem Solving?



Immediate issues that teachers raise are:

- Unstructured problems are more **difficult**.
- It is more **difficult** to plan a lesson with these problems.
- Students may **not know how to get started** on them. Will we therefore need to structure them anyway?
- Students will not necessarily use what we have taught them.
- If we offer help too quickly, **students will** simply do what we say and **not think for themselves**.
- Students will generate a greater variety of approaches and solutions.
- Students may **not collaborate in an effective way**. (One student may take over).

What do teachers need to know when implementing non-routine problem solving?

BE LESS HELPFUL



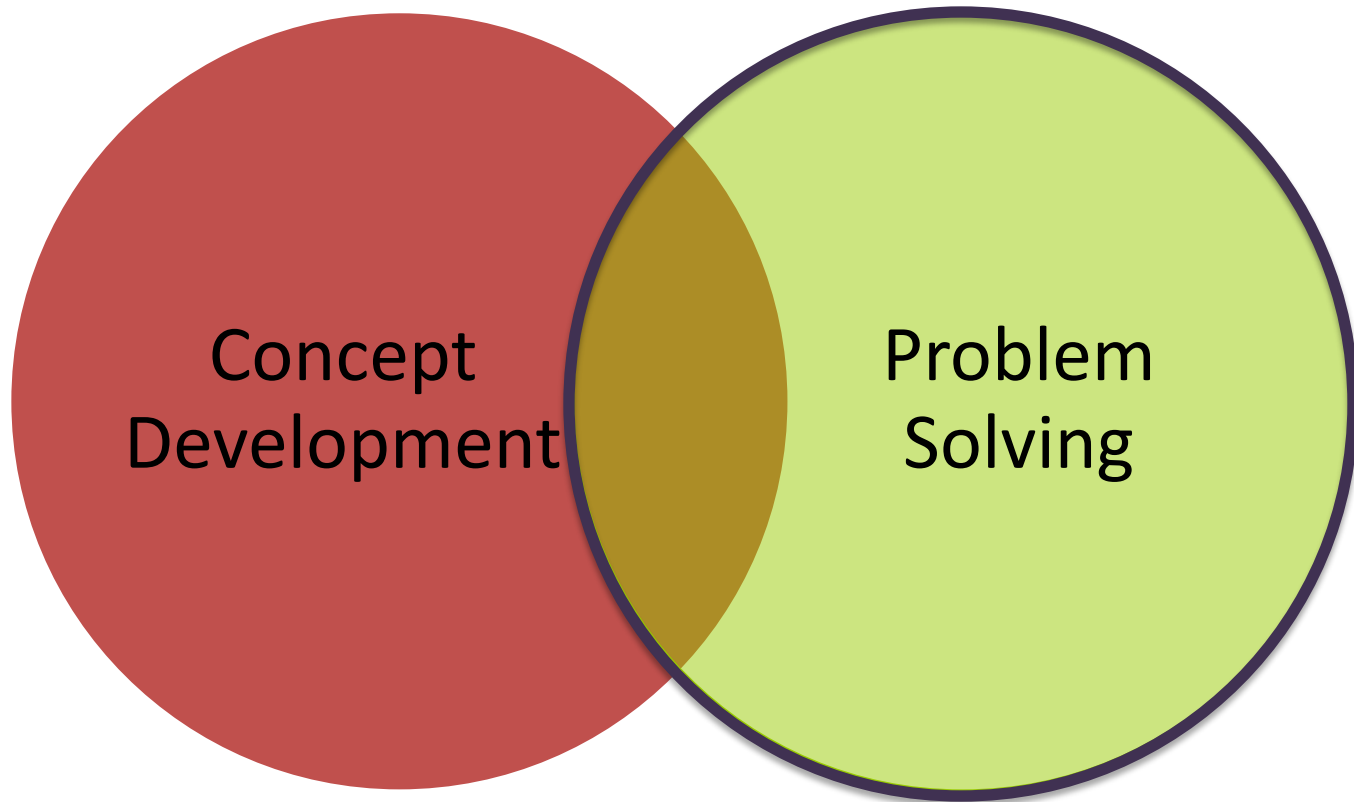
Critical Points in Problem Solving

- It is important for the students to engage with the task holistically – *if you need to clarify it, perhaps for students with reading difficulties, make sure you don't break it into steps or smaller tasks.*
- Avoid problem specific suggestions or questions. Keep to strategic questions: *What have you done so far (and why)? What do you know ?*
- Ask questions related to problem solving strategies –
*Have you organized what you know, and what else you need to find out?
How might you represent this with mathematics?*
- The whole class discussion at the end is important for student learning.

Math Design Collaborative is working to make better problem solvers by providing teachers better problems and a framework for creating problem solving opportunities.

Two Types of FALs

Classroom Challenges



Two Types of FALs

Concept Development

Lessons are meant to first reveal students' prior knowledge, then develop students' understanding of important mathematical ideas, connecting concepts to other mathematical knowledge.

Problem Solving Lessons

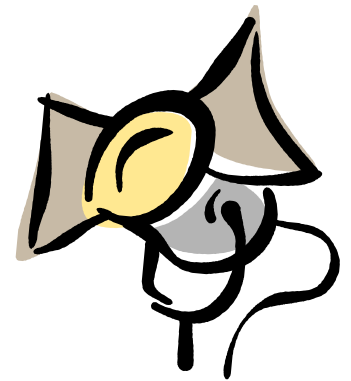
are meant to assess, then develop students' capacity to apply their mathematical thinking flexibly to non-routine, **unstructured problems** – within mathematics and with real world applications.

Benefits of Problem Solving Lessons

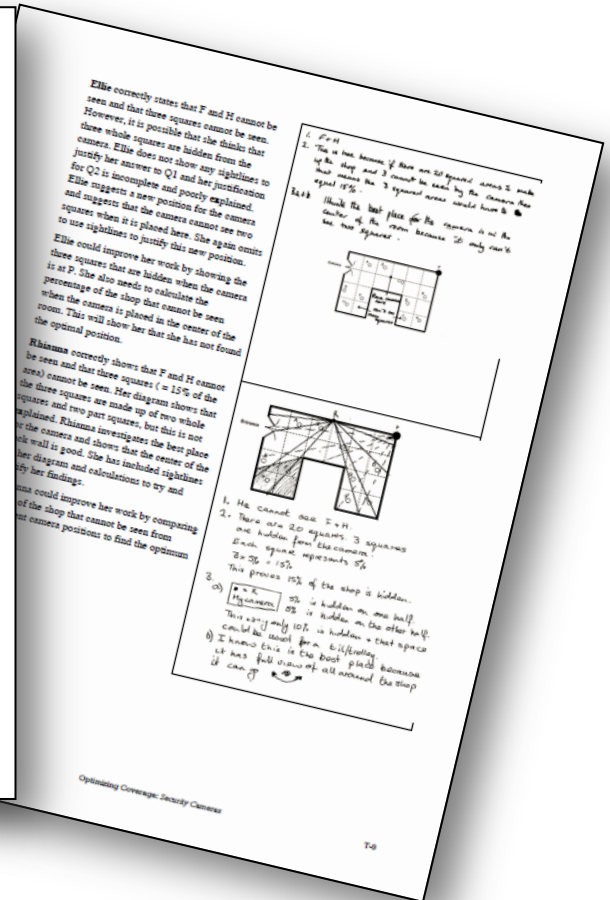
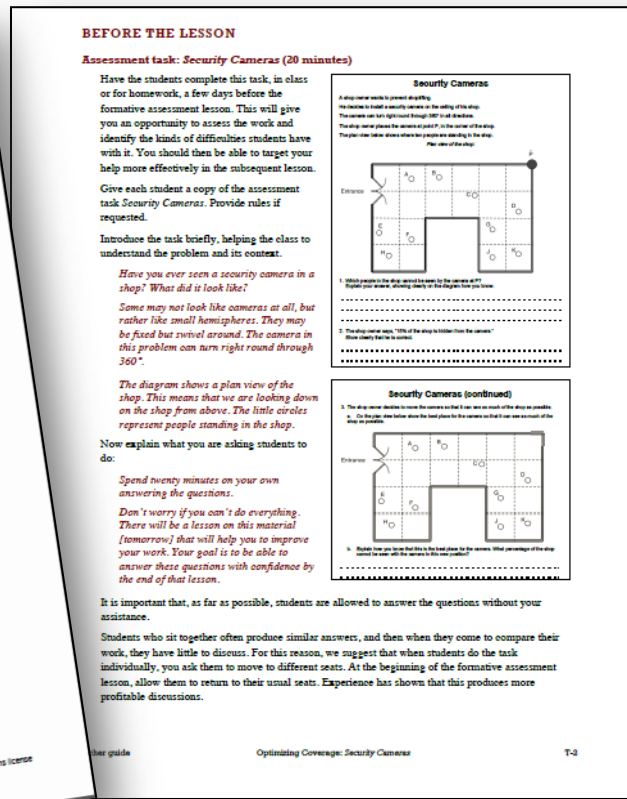
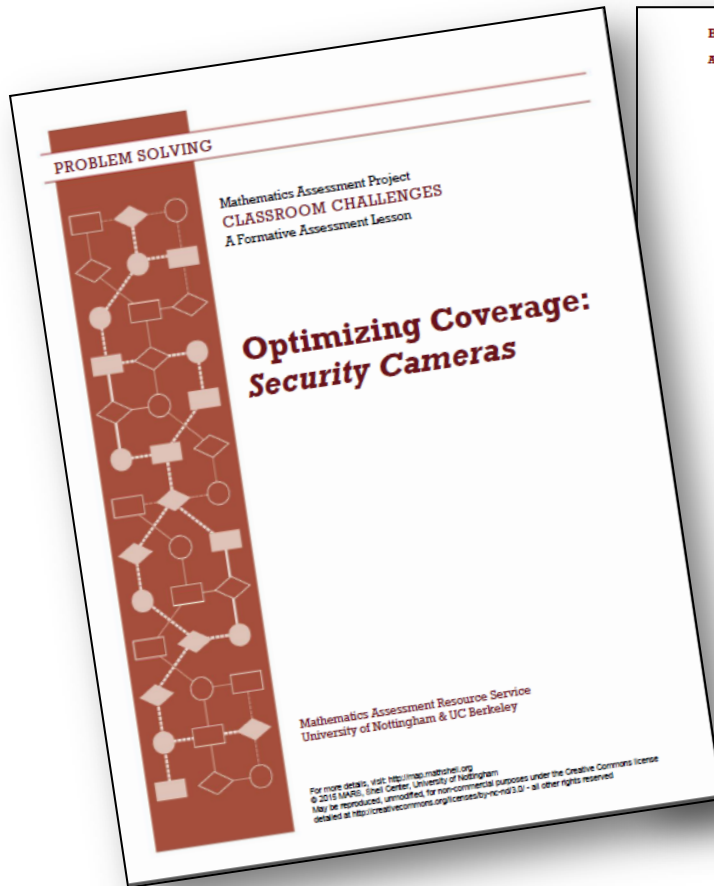
- Students are **sharing ideas**, communicating/explaining methods
- Exposed to **multiple approaches**
- Exposed to unique, **non-routine** problems
- Required to **analyze** other students' work
- Required to **diagnose others' errors** and misconceptions
- Required to **make decisions** about best method

MDC spotlights: Standards for Mathematical Practice

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.



Let's take a Look



Can you find all of the key elements of Formative Assessment?

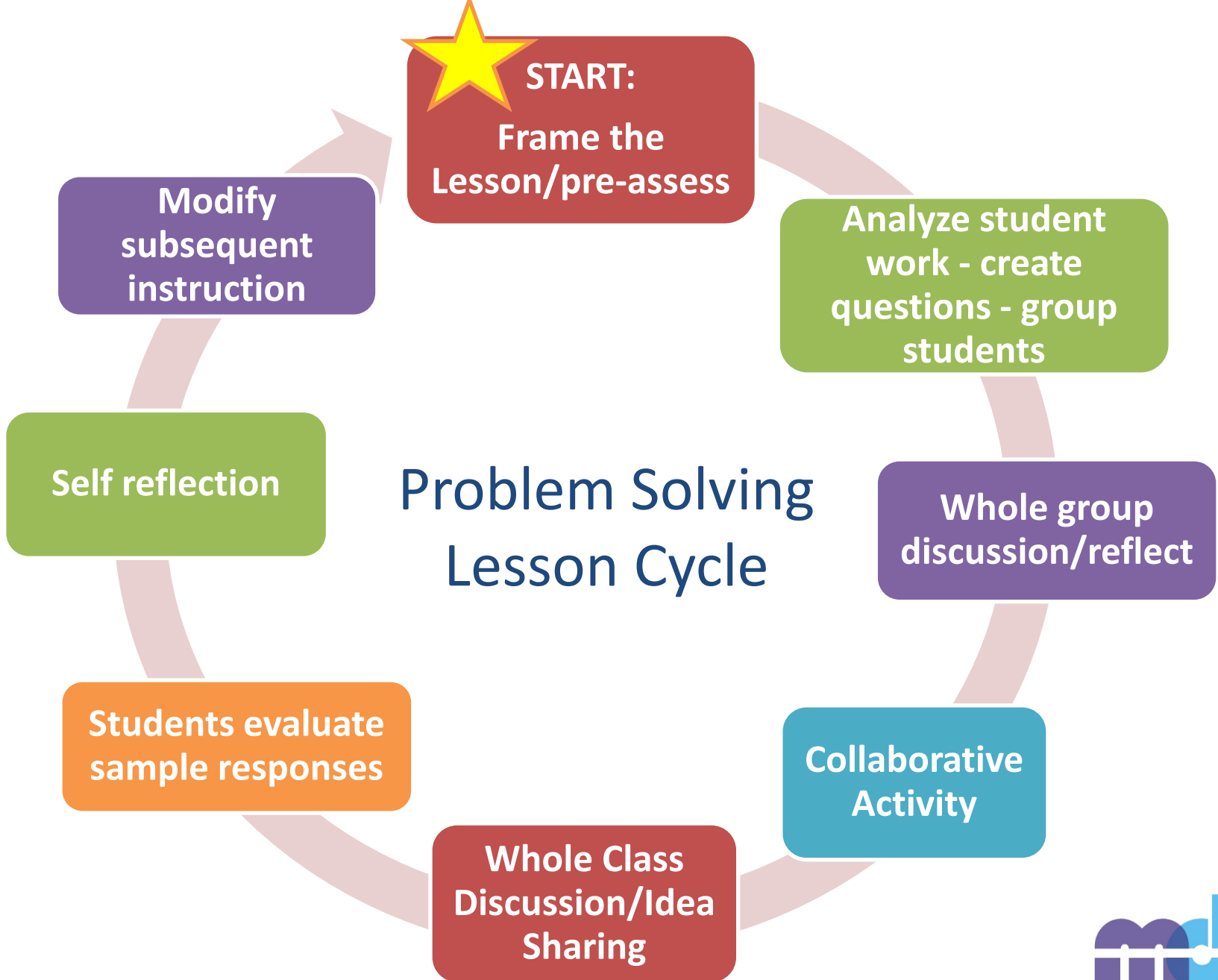
Problem Solving Lesson and Formative Assessment

Steps in Problem Solving FAL

- Frame the lesson and administer the pre-lesson assessment
- Analyze student responses and write feedback questions
- Distribute the feedback questions and responses to the pre-lesson assessment
- Facilitate students working collaboratively
- Facilitate whole group discussion
- Administer the student reflection sheet
- Data analysis and modify accordingly

Formative Assessment

- Clarification
- Engineering effective discussion, questions, activities , and tasks for evidence of learning
- Providing Feedback that moves learners forward
- Activating students as instructional resources
- Activating students as owners of their own learning.

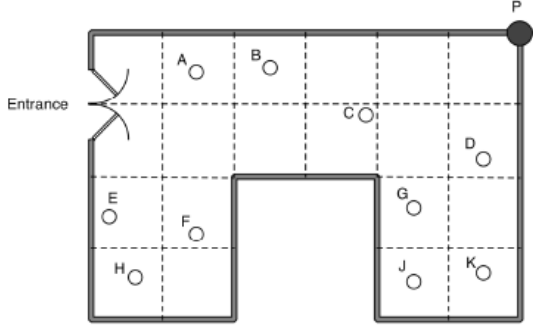


Framing the Lesson

- Give each student a copy of the problem and the task.
- Give students approx. 20 minutes to work thought problem independently.
- **Collect after 20 min.**
- *Students should not worry too much if they cannot understand or do everything.*
There is no one right or wrong answer.

Security Cameras

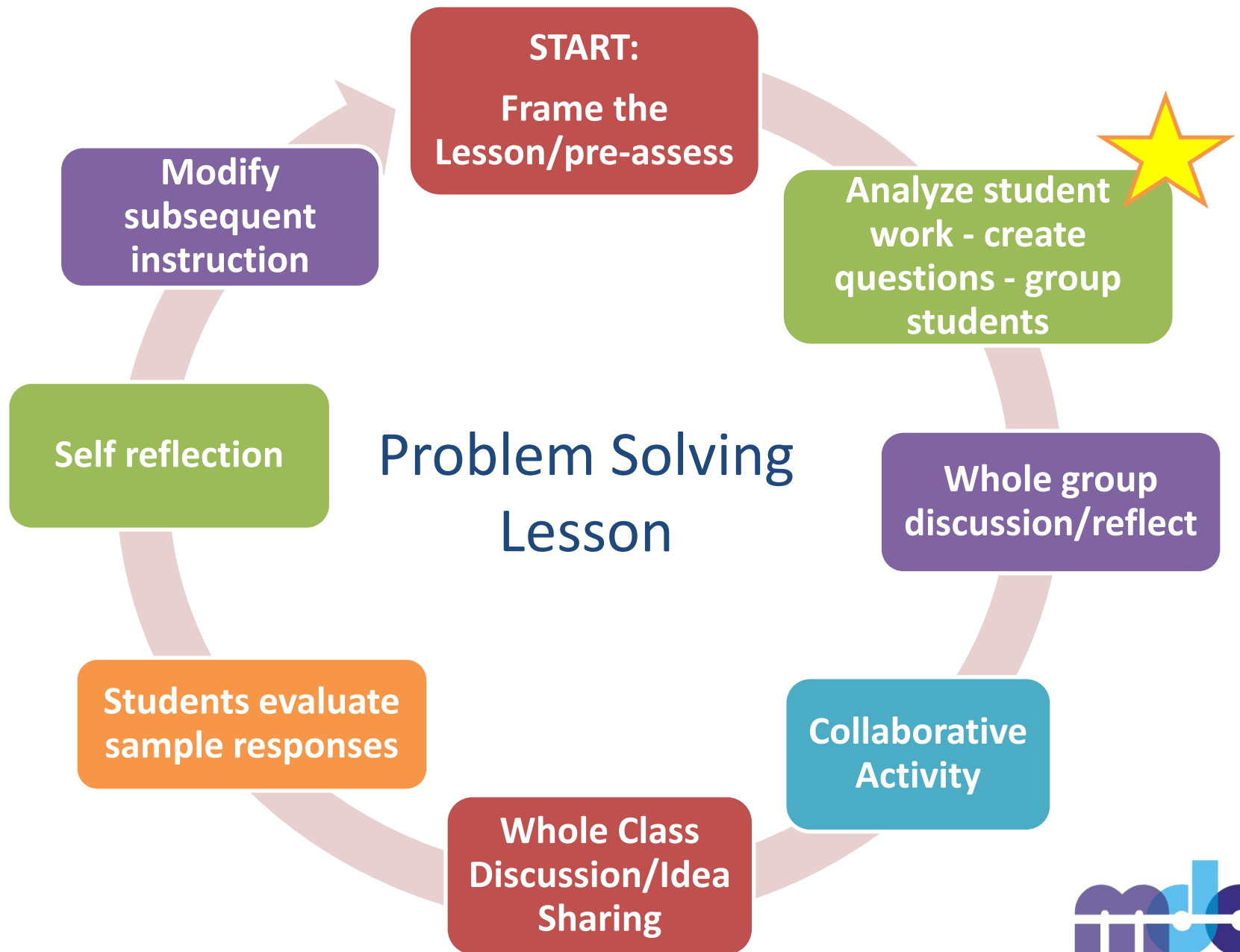
A shop owner wants to prevent shoplifting.
He decides to install a security camera on the ceiling of his shop.
The camera can turn right round through 360° in all directions.
The shop owner places the camera at point P, in the corner of the shop.
The plan view below shows where ten people are standing in the shop.
Plan view of the shop:



1. Which people in the shop cannot be seen by the camera at P?
Explain your answer, showing clearly on the diagram how you know.

2. The shop owner says, "15% of the shop is hidden from the camera."
Show clearly that he is correct.

Student materials Optimizing Coverage: Security Cameras
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Look for...

- Common difficulties/misconceptions/issues
- Common problem solving strategies and unique approaches
- Think about what needs you will need to address to keep the learning moving forward
- How will I group the students for the collaborative activity? (**Heterogeneous grouping**)

Record Data

Subject:					
Formative Assessment Lesson:					
Total Number of Students:		10			
Total Percentage	<i>Pre-Test</i>	0%	0%	0%	0%
	<i>Post-Test</i>	0%	0%	0%	0%
Total Count	<i>Pre-Test</i>	0	0	0	0
	<i>Post-Test</i>	0	0	0	0
		Student Miscon			
Student					
1	<i>Pre-Test</i>				
	<i>Post-Test</i>				
2	<i>Pre-Test</i>				
	<i>Post-Test</i>				
3	<i>Pre-Test</i>				
	<i>Post-Test</i>				
4	<i>Pre-Test</i>				
	<i>Post-Test</i>				
5	<i>Pre-Test</i>				
	<i>Post-Test</i>				

Analyze the Data

- To create feedback questions
 - Guiding students toward a deeper understanding
 - Moving students forward
- To group students
 - Homogeneously in Concept Development Lessons
 - Heterogeneously in Problem Solving Lessons
- To prepare for the whole group discussion
 - Knowing what to listen for as students are working
 - What content might need addressed

Common Misconceptions

Common issues:	Suggested questions and prompts:
Student has difficulty getting started	<ul style="list-style-type: none"> What do you know? What do you need to find out? Can you describe in words what happens during the first five months?
Student does not develop a suitable representation for the problem	<ul style="list-style-type: none"> Can you make a diagram or table to show what is happening? Can you show time elapsing on your diagram? How can you show which kittens are descended from which? How can you show the numbers of kittens at each month?
Student's work is unsystematic	<ul style="list-style-type: none"> Can you think of a way of breaking the task into manageable chunks? Could you start by just looking at the litters from the first cat? Then what would you do after that? Can you now look systematically at what happens to her kittens? And their kittens?
Student develops a partial model For example: The student only considers litters from the original cat. Or: The student only considers the first litter at each generation.	<ul style="list-style-type: none"> Do you think the first litter of kittens will have time to grow and have litters of their own? Then what about their kittens? Do you think that the first cat will have time to have more than litter? What about her kittens?
Student does not make assumptions explicit For example: The student does not write that she has decided that all the litters occur in the first six months of the year. Or: The student does not state that she is assuming all the kittens are female.	<ul style="list-style-type: none"> What have you assumed here?
Student makes unreasonable assumptions For example: The student decides that all the kittens born in a year are born at the beginning of that year.	<ul style="list-style-type: none"> Is your assumption that [all these kittens are born at the beginning of the year] reasonable?
Student has made a successful attempt	<ul style="list-style-type: none"> Do you think that your work gives the maximum possible number of kittens? How can you be sure? Can you find a different way of presenting your analysis? Which way is clearest? Do you think your answer is an overestimate or underestimate? Why? Can you suggest reasonable bounds for your estimate?

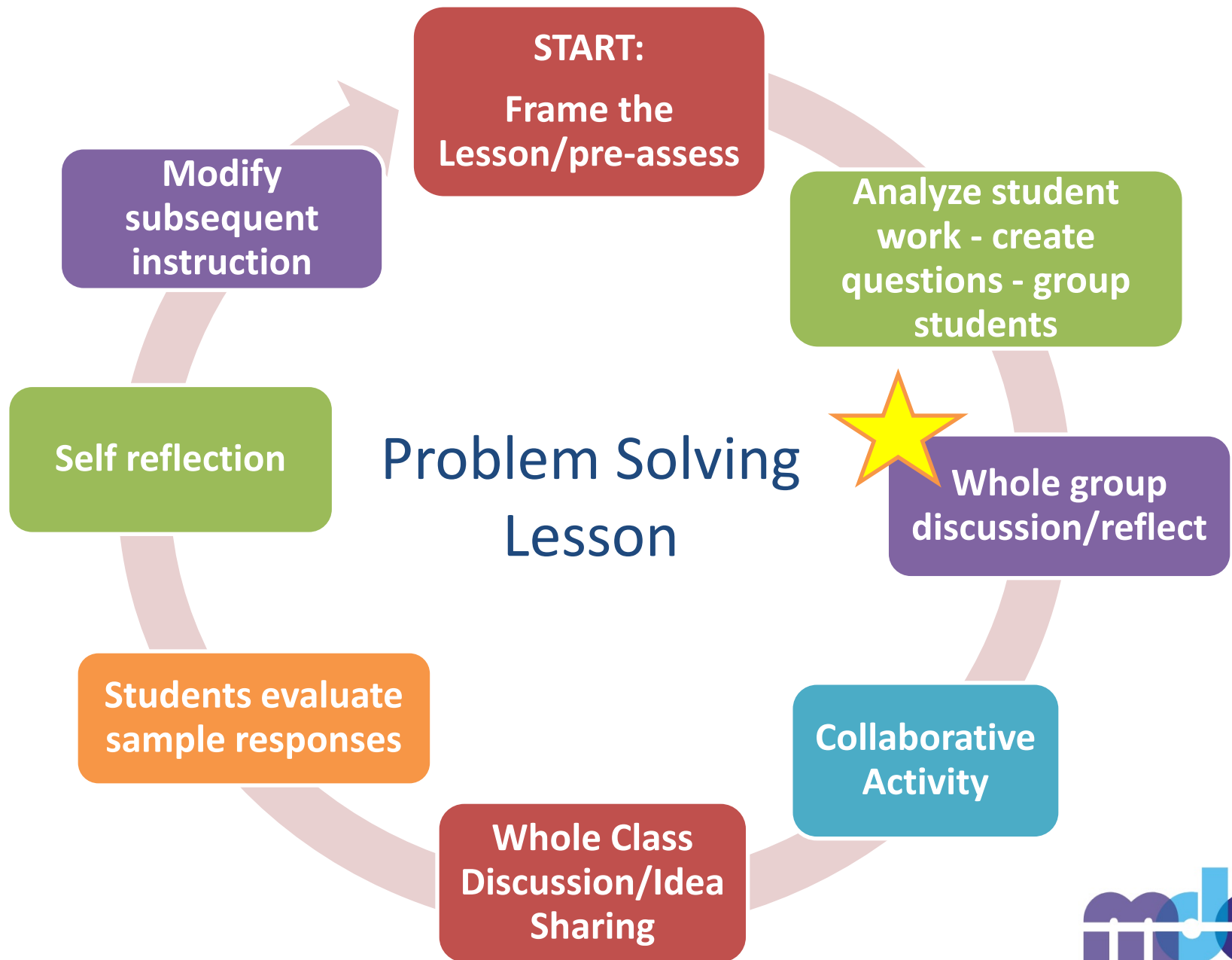
Teacher guide

Modeling: Having Kittens

T-3

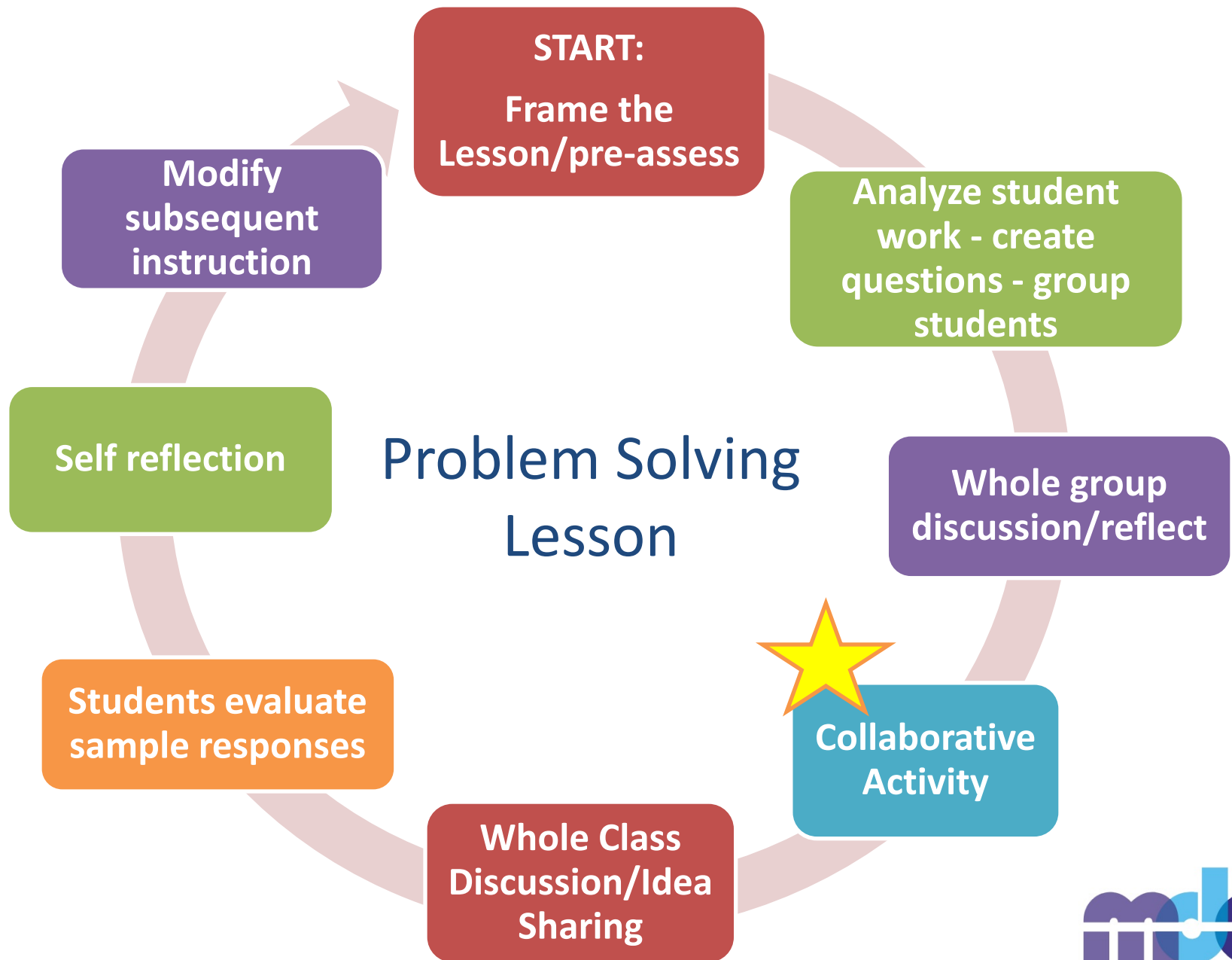
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“Don’t prevent mistakes, plan for them.”



Whole Group Discussion

- Pass back student work
- Give time for students to reflect on feedback
- Ask questions
 - Is that enough to convince someone of your answer?
 - Show me how you represented this information.



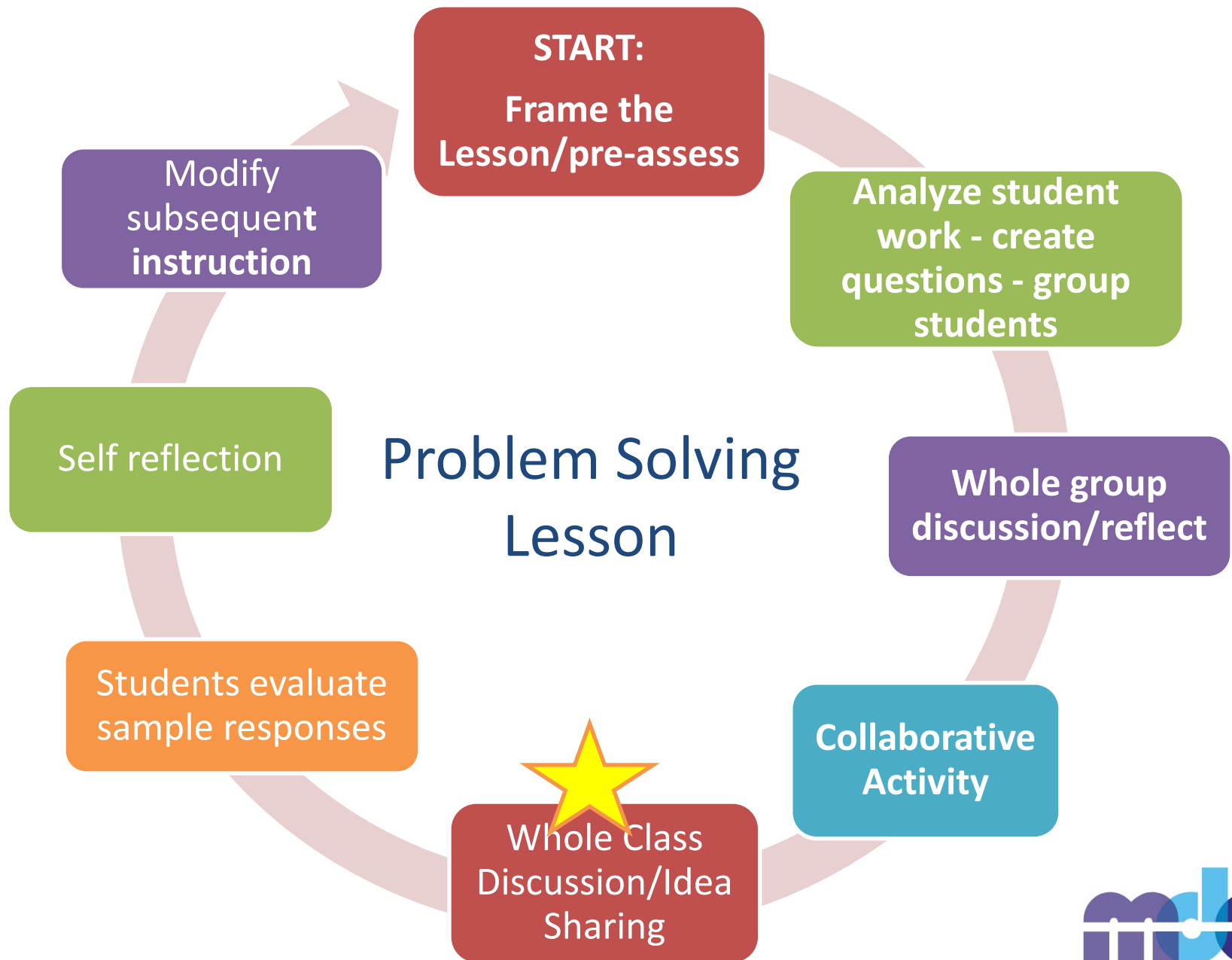
Collaborative Activity

- Heterogeneously group students to create one solution. (2-3 students)
 - Take note of different approaches to the problem
 - Encourage dialog between partners
 - Combine strategies- create a poster
 - Support problems solving



Activity: Planning a Joint Method

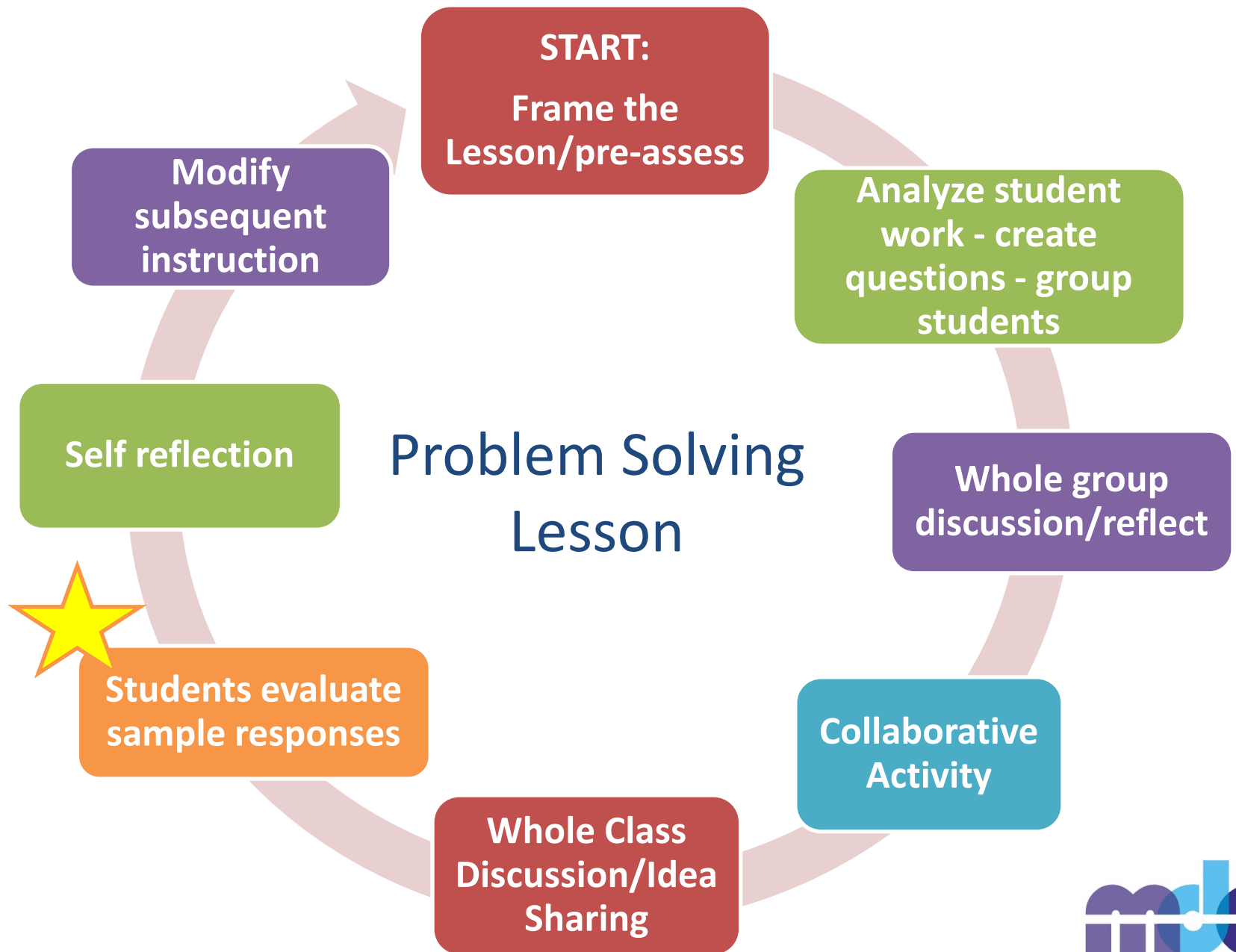
1. Take turns to explain your method and how you think your work could be improved.
2. Listen carefully to each other.
 - Ask questions if you don't understand.
3. Once everyone in the group has explained their method, plan a joint method that is better than each of your separate ideas.
4. Create a poster showing your work and solution.
5. Make sure that everyone in the group can explain the reasons for your chosen method.



Poster Share

- Students visit other groups to share posters or share to the whole group.
 - Did they choose a good method?
 - Did they make sensible assumptions?
 - Is their reasoning correct?
 - Are their calculations accurate?





Evaluating Student Sample Responses

1. Imagine you are the teacher and have to assess the student work.
2. Work through a students' solution.
Write your answers on your mini-whiteboards.
3. Explain your answer to the rest of the group.
4. Listen carefully to explanations.
 - Ask questions if you don't understand.
5. Once everyone is satisfied with the explanations, write the answers below the student's solution.
 - Make sure the student who writes the answers is not the student who explained them.
6. Work through each response using this protocol.

Sample Responses to Discuss: Simon

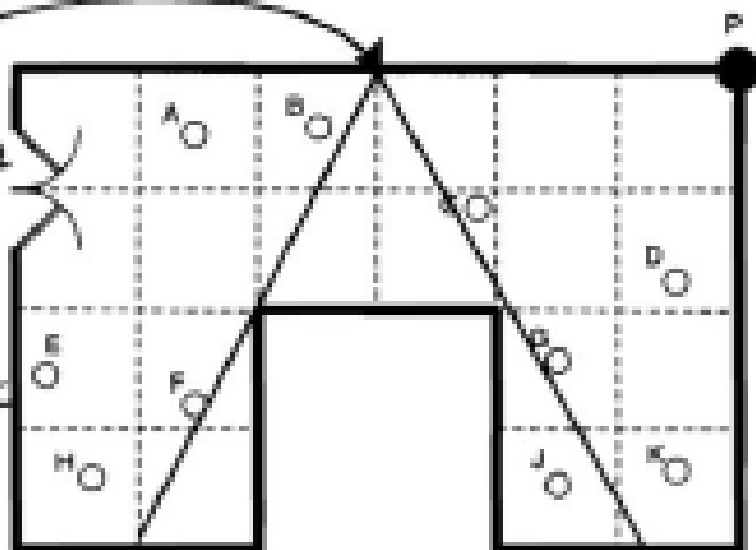
1. E, F and H cannot be seen by the camera.

2.

3.

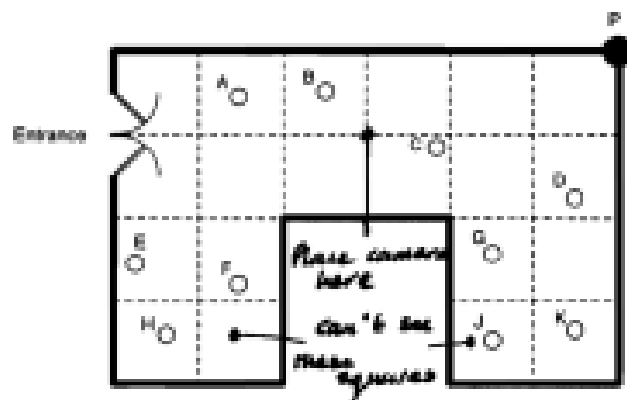
a. Here is the best place
Entrance

b. it can see almost every where

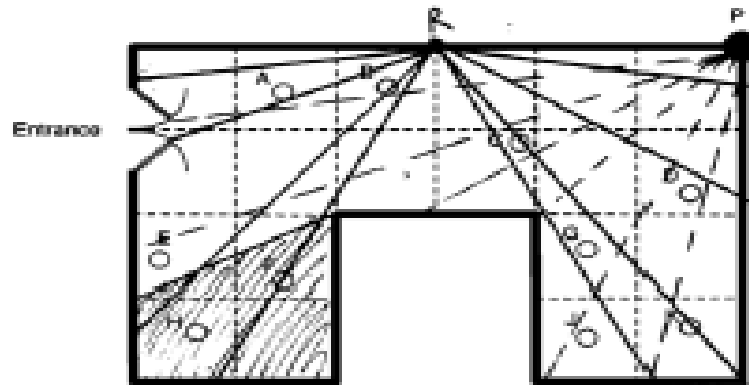


Sample Responses to Discuss: Ellie

1. $F + H$
 2. This is true because if there are 20 squared areas to make up the shop and 3 cannot be seen by the camera then that means the 3 squared areas would have to equal 15%.
- 3a+b I think the best place for the camera is in the center of the room because it only can't see two squares.




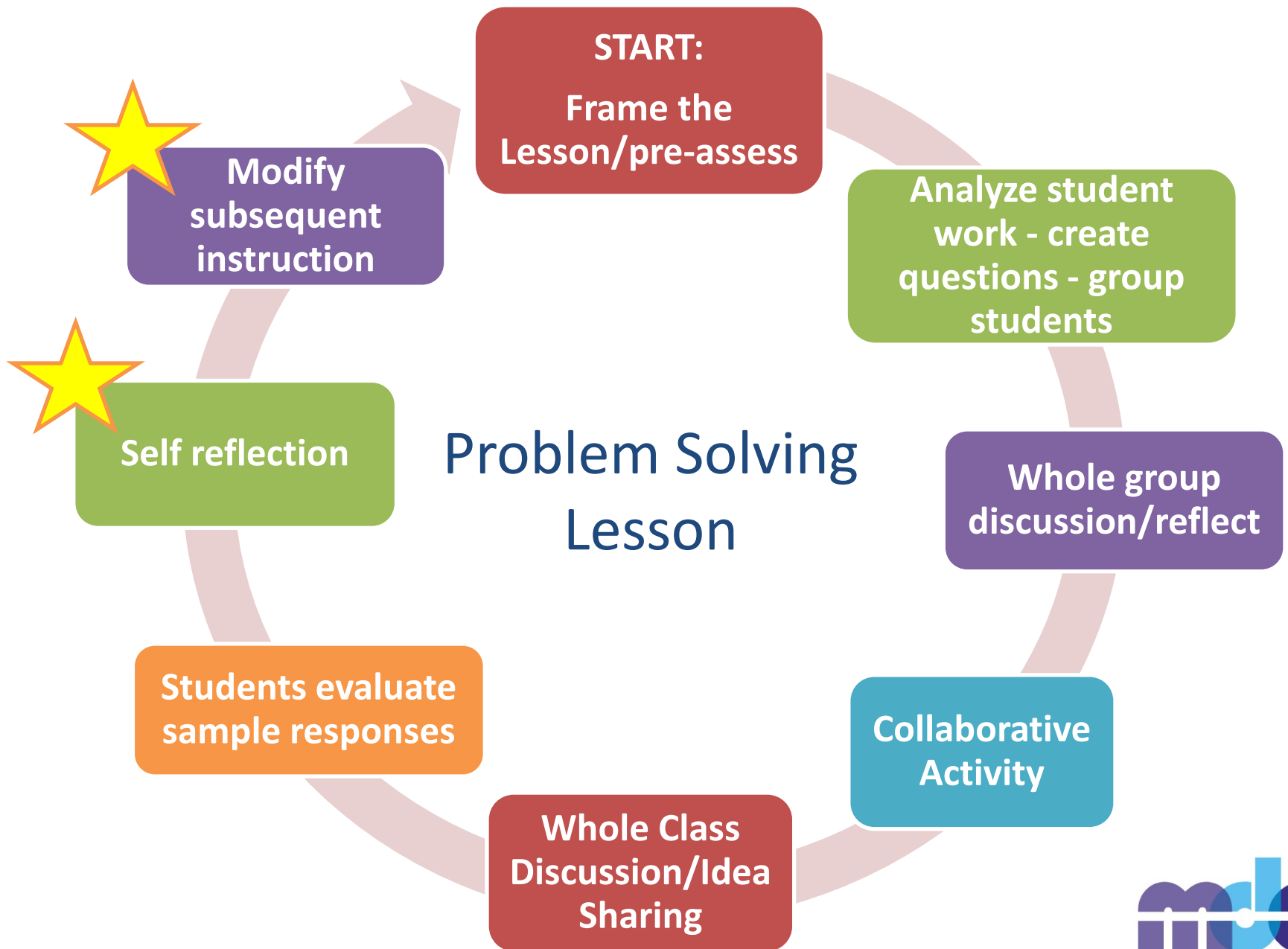
Sample Responses to Discuss: Rhianna



1. He cannot see F + H.
2. There are 20 squares. 3 squares are hidden from the camera.
Each square represents 5%
 $3 \times 5\% = 15\%$
This proves 15% of the shop is hidden.
3. a)

● = R	5% is hidden on one half.
My camera	5% is hidden on the other half.

This way only 10% is hidden + that space could be used for a trolley/trolley.
b) I know this is the best place because it has full view of all around the shop it can go 



Self-Reflection

How Did You Work?

Tick the boxes and complete the sentences that apply to your work.

1. Our group work was better than my own individual work ☐

Our joint solution was better because

2. We justified our solution ☐

We justified our solution by

3. Our method is similar to one of the sample responses ☐

OR

- Our method is different from **all** of the sample responses ☐

Our method is similar to
(add name of sample response)

Our method is different from all of the sample responses

I prefer **our method** / **the sample response** (circle)

because

This is because

4. In our method we assumed that:

.....

What do students say?



Reflecting on the Critical Points in a Problem Solving FAL

- After viewing a Problem Solving FAL, reflect on the questions on page 9.
- What do these critical points look like in a classroom?
- What challenges do you face with problem solving in your classroom?
- How could the MDC Problem Solving framework support your efforts?

MDC Follow-Up Commitment

1. Plan to implement a Formative Assessment Lesson of your own(problem solving or concept development).

- Choose a lesson from the MDC resources
- OR-
- Create your own MDC Lesson

2. Schedule a virtual meeting to share lesson with one of the presenters.

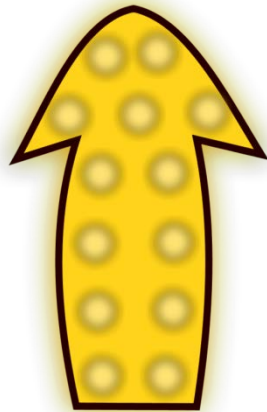
3. Schedule for an onsite visit.

****All work must be completed by May 27, 2016 to receive ACT 48 hours.**



Teacher Survey

<http://tinyurl.com/hrfo6j9>



Thank you for your
attendance, attention and
participation.

See you on March 21, 2016!

